VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the Title:

The title has been amended as follows:

-- [An uncertain and complex] Statistical mechanics system teaches neural networks --

In the Other References

The following references have been added as follows:

-- W. Kahan, *Branch Cuts for Complex Elementary Functions*, in *The State of the Art in Numerical Analysis* eds. A. Iserles & M. J. D. Powell, Clarendon Press, Oxford, 1987.

J. Helmick, Quantum Theory: reconsideration of foundations (Conference), A. Khrennikov ed., *A Non-Congruential Generator Extracts Descending Objects to Finite Sets of Zero Vector* (Abstract presentation), , Vaxjo Univ. Press, Sweden, June 2001.

J. Helmick, Proceedings of the Conference on Quantum Theory: reconsideration of foundations, A. Khrennikov ed., *Set Theory to Physics* (Pre-print), Vaxjo Univ. Press, Vaxjo, 2002. --

In the second reference the title is changed to:

-- R.D. Sriram, *Intelligent Systems for [Engineers] Engineering*, Springer-Verlag, Berlin, 1997, pp.341, 471-513. --

In the Background of the Invention

Page 3 paragraph 1 line 1 has been amended as follows:

-- The invention presents [an uncertain and complex] a statistical mechanics system of non-congruential algorithms that teaches Artificial Neural Networks nonlinear functional mapping for control and numerical modeling, and among the more particular, to manipulate generated output of multiple sequences and to implement a new operating system. --

In the Summary of the Invention

Page 3 paragraph 1 line 10 has been amended as follows:

-- Analysis of the two most widely used transcendental numbers e and π extends from classical mechanics to mathematical applications like computing billions of digits of π. The computation of digits to extraordinary lengths demonstrates the value of mathematics to computer science. Introspection on the quantum aspect of the decimal expansions of e, π, $(2)^{1/2}$ and $(3)^{1/2}$ is more intuitively understood from the statistical mechanics of decimal positions relative to special angles in degrees and radians on the unit circle. "Numerical-learning-based algorithms focusing on Artificial Neural Networks", i.e. Multilayer Perceptron Network, Kohonen Self-Organizing Network, and Hopfiield Network have not yet learned the "nonlinear mapping functions for control and numerical modeling from input sets to output sets" of this [uncertain] non-congruential system. --

Page 3, paragraph 2 line 3 has been amended as follows:

--Application of the non-standard theory $-(-a) = -a$ extends from arbitrary degrees to a measure of the natural scale of Euclidean geometry with a secondary extension to a complex _yod_ group of symmetric and descending objects with one embedded quaternionic orbit. At the end of the $-(-a) = -a$ *yod* group descent, $5\pi/4$ on the unit circle makes sense in terms of $-x = -y$ for a logical approach to a definition of *zero vector* in polar coordinates. Numeric simulations of the algorithms at 1,000,000 LengthOfString digits display preliminary evidence of convergence by the output of many sequences --

Page 3, the second to last line has been amended as follows:

-- The values $(2)^{1/2}$ and $(3)^{1/2}$ are specifically chosen because 2 and 3 are the only operands of the square root function in the solutions to sine, cosine and tangent computations from the standard double negative equals a positive view of the Pythagorean theorem and the special angles on the unit circle. Furthermore, operation of the zero factor property is questioned in the multiplicative identity of zero when defined as an operation of repeated addition. Last, propositional functions are constructed from the extraction/_detection_ of numerical sequences. --

Page 4, paragraph 1 lines 2 and 3 have been amended as follows:

-- The reason why the isosceles triangle of Hilbert's 7th problem was chosen to triangulate the mechanism of extraction/_detection_ (Δ) is because the angle and length ratios are in pairs just as the special angle seed matrices extract/_detect_ digit pairs from e and π, $(2)^{1/2}$ and $(3)^{1/2}$. Since there are only 3 angles and 3 sides to the Hilbert isosceles triangle, then only three input values run simultaneously appear to make sense. But the operands 2 and 3 appear in the trigonometric computations of the Pythagorean theorem on the unit circle. Therefore, $(2)^{1/2}$ and $(3)^{1/2}$ are included as separate simulations the same as e and π, and all four input values are tested as well. Also the one-to-one correspondence of decimal positions to arbitrary degrees on the unit circle and the one-to-

one correspondence of degrees-radians conversion imply a special angles in radians to decimal positions one-to-one correspondence thereby completing the isosceles triangle. --

In the Brief Description of the Drawings

FIG.1 has been amended as follows:

--FIG. 1 shows a map of the closed loop for the [uncertain and complex] statistical mechanics system; --

In the Detailed Description of the Invention

Page 4 paragraph 1 has been amended as follows:

-- The [uncertain and complex] closed loop of FIG. 1 represents [an uncertain and complex] a statistical mechanics system with phase space transitions of arbitrary degrees to natural radians, natural radians to *yod*, and *yod* to *zero vector*. The nonlinear functional mapping from input to output of each operator, Δ representing ***match-with-rotate*** algorithm, *yod* representing ***cusp root method***, and ***zero vector*** algorithm needs to be defined. Therefore numerical-learning-based algorithms focusing on Artificial Neural Networks are used as learning tools for control and numerical modeling from input to output sets. --

After paragraph 1 in the Detailed Description of the Invention on page 4, the following paragraph has been inserted as follows:

-- The operational function, $dL/d\theta$ where L is LengthofString for π, e, $(2)^{1/2}$ or $(3)^{1/2}$ decimal expansions and θ is the 16 special angles converted from degrees to radians, is expressed as a quotient of integers where the numerator is in terms of length of decimal position and the denominator in terms of degrees/radians on the unit circle *mod 360*. --

Page 6, paragraph 4, lines 5 and 6 have been amended to:

-- The output sequences for all combinations of seed matrices in 1.) matching digits 2.) matching special angles in degrees or radians 3.) matching special angle positions 4.) matching special angle positions in terms of sector-area and 5.) one, two, three, or four input remainder values segmented by $x_n - x_{n-1} = r_n$ with empty digit positions intact where the matching digits were extracted/detected from, extend to infinity defined as 1/0 at the origin and are symbolized by the non-Euclidean $\pm 0^\circ$-90°-90° intermediary structure. The sequences recombine in permutations of an extraneous dimension at the origin of polar coordinates. A graph of the distribution of matching digits and matching special angles for 286 coordinate pairs (of which 76 are noted on the graph) (FIG. 6) shows symmetry of bilateral concavities and suggests a relation common to matching digits and matching special angles. --

The last paragraph beginning on page 6 to page 7 in line 4 has been amended to:

-- The total number of generated sequences depends on the number of input values. The input remainder values segmented by $x_n - x_{n-1} = r_n$ where the matching digits are segmented according to the factor theorem such that, if r (decimal position of matching digits) is a zero of the polynomial $P_{(x)}$ (input values) then (x - r) is a factor of $P_{(x)}$. The decimal position of matching digits is defined as a segment length from $x_0 = 0$ for the start of e, π, $(2)^{1/2}$ and $(3)^{1/2}$ in combinations of two, three and four input values, and x_1 = decimal position of the first matching digits, then $x_1 - 0 = r_1$, $x_2 - x_1 = r_2$, ... $x_n - x_{n-1} = r_n$ and for each extracted/detected digit position, a term from the matching special angle sequence is inserted in a one-to-one correspondence as the y-component (for height on the unit circle) in an ordered pair such that ($x_n - x_{n-1} = r_n$, matching special angle) equals the (x, y) coordinate pair. The matching special angle positions sequence in terms of sector-area are also matched in a one-to-one correspondence with the ($x_n - x_{n-1} = r_n$, matching special angle) coordinate pairs such that the digits of the x-component are distributed in clusters (according to frequency of digits occurring in the x-component) over the sector-area. The coordinate pair y-component (matching special angles) is the height on the unit circle and is one-to-one correspondence with the matching special angle positions (in terms of sector area). --

Page 7 paragraph 1 line 3 has been amended to include a ± as follows:

-- *Zero vector* is determined by θ only and corresponds to the null set (FIG. 5) of the *yod* group, for example in the 16 special angles from $0 + 0\pi k + 0$ to $0 + 2\pi k + 0$ on the polar origin. Implementation of a non-Euclidean metric ±0°-90°-90° triangle (FIG. 1) is an example of a random tool designed for an infinite task. Definition of *zero vector* and elementary properties of vectors in a probability context suggest the curvature of a line between 2 points on a non-Euclidean surface results in the behavior of "shortest" lines such that 1.) a ±0 domain with +0 intersect –0 = vacuous, 2.) vacuous does not equal True or False, 3.) null intersect null = disjoint, and 4.) *a* does not equal zero, *a* such that $a^2 = 0$, 4.) sum of vectors in the identity element law is non-commutative by **a + 0** does not equal **0 + a**, 5.) the commutative property of multiplication defined as a repeated series of addition such that adding zero five times is valid but adding 5 zero times is not valid, and 6.) the four values of minimum-maximum $\pm\infty = 1$ of an operating system. --

Page 7 paragraph 2 lines 1 and 2 have been amended to include a "±" as follows:

-- The non-Euclidean ±0°-90°-90° metric, which extends to infinity at the vertex, is an intermediate form of the Δ Hilbert isosceles triangle. In the ±0°-90°-90° metric, however, the ratio of orthogonal base angles to the vertex angle at infinity present polar coordinates at the origin that depend only on θ for the direction of "shortest" lines radii. --

Page 7 paragraph 3 line 1 has been amended as follows:

-- The balanced ratios of the [uncertain] system are: (16/16; 7/16 6/16 5/16 4/16 3/16 2/16 1/16; 16/16) that corresponds to 16 by 7 by 16 symmetry and (16/16; 7/16 6/16 5/16;

4/16 (infinite loop); 3/16 2/16 1/16; 16/16) that corresponds to 16 by 3 by 1 by 3 by 16 symmetry (FIG. 7) and the case 16 by 8 for null set = *zero vector* as an element of *yod*. –

Page 8 after the end of the first 6 lines and before the paragraph beginning with "Similar in function ..." the sentence and code has been added as follows:

-- *Match-with-rotate* is coded in Mathematica as follows:

```
Programming Parameters & Packages
    Needs [ "Graphics ' Graphics' " ]
    Needs [ "Statistics ' DataManipulation ' " ]

    LengthofString = 1000000

Digit Representations

    d = RealDigits [ E, 10, LengthofString ] [ [1] ] ;
    c = RealDigits [ Pi, 10, LengthofString ] [ [1] ] ;

Digit Representations in Special Angles

    SpecialAngles =

      (Table [
        { 0 + 2 Pi k + 30, 0 + 2 Pi k + 30 + 15, 0 + 2 Pi k + 30 + 30, 0 + 2 Pi k + 30 + 60, 0 + 2 Pi k + 30 + 90,
         0 + 2 Pi k + 30 + 15 + 90, 0 + 2 Pi k + 30 + 30 + 90, 0 + 2 Pi k + 30 + 60 + 90, 0 + 2 Pi k + 30 + 180,
         0 + 2 Pi k + 30 + 15 + 180, 0 + 2 Pi k + 30 + 30 + 180, 0 + 2 Pi k + 30 + 60 + 180,
         0 + 2 Pi k + 30 + 270, 0 + 2 Pi k + 30 + 15 + 270, 0 + 2 Pi k + 30 + 30 + 270,
         0 + 2 Pi k + 30 + 60 + 270} , { k, 0, .95 LengthOfString / 360 } ] / / Flatten ) /. Pi → 180 ;

    cc = Part [ c, (Table [
         { 0 + 2 Pi k + 30, 0 + 2 Pi k + 30 + 15, 0 + 2 Pi k + 30 + 30, 0 + 2 Pi k + 30 + 60, 0 + 2 Pi k + 30 + 90,
         0 + 2 Pi k + 30 + 15 + 90, 0 + 2 Pi k + 30 + 30 + 90, 0 + 2 Pi k + 30 + 60 + 90, 0 + 2 Pi k + 30 + 180,
         0 + 2 Pi k + 30 + 15 + 180, 0 + 2 Pi k + 30 + 30 + 180, 0 + 2 Pi k + 30 + 60 + 180,
         0 + 2 Pi k + 30 + 270, 0 + 2 Pi k + 30 + 15 + 270, 0 + 2 Pi k + 30 + 30 + 270,
         0 + 2 Pi k + 30 + 60 + 270} , { k, 0, .95 LengthOfString / 360 } ] / / Flatten ) /. Pi → 180
      ] :

    dd = Part [ d, (Table [
         { 0 + 2 Pi k + 30, 0 + 2 Pi k + 30 + 15, 0 + 2 Pi k + 30 + 30, 0 + 2 Pi k + 30 + 60, 0 + 2 Pi k + 30 + 90,
         0 + 2 Pi k + 30 + 15 + 90, 0 + 2 Pi k + 30 + 30 + 90, 0 + 2 Pi k + 30 + 60 + 90, 0 + 2 Pi k + 30 + 180,
         0 + 2 Pi k + 30 + 15 + 180, 0 + 2 Pi k + 30 + 30 + 180, 0 + 2 Pi k + 30 + 60 + 180,
         0 + 2 Pi k + 30 + 270, 0 + 2 Pi k + 30 + 15 + 270, 0 + 2 Pi k + 30 + 30 + 270,
         0 + 2 Pi k + 30 + 60 + 270} , { k, 0, .95 LengthOfString / 360 } ] / / Flatten ) /. Pi → 180
      ] :
```

```
Length [ cc ]

Special Angle Number ( 1 = Pi / 6, 2 = Pi / 4 ...) for Matching Digit Positions

Flatten [ Position [ Table [ dd [ [ k ] ] == cc [ [ k ] ] , { k, 1, Length [ cc ] } ] , True ] ]

Matching Special Angles

Part [
  (Table [
    { 0 + 2 Pi k + 30, 0 + 2 Pi k + 30 + 15, 0 + 2 Pi k + 30 + 30, 0 + 2 Pi k + 30 + 60, 0 + 2 Pi k + 30 + 90,
     0 + 2 Pi k + 30 + 15 + 90, 0 + 2 Pi k + 30 + 30 + 90, 0 + 2 Pi k + 30 + 60 + 90, 0 + 2 Pi k + 30 + 180,
     0 + 2 Pi k + 30 + 15 + 180, 0 + 2 Pi k + 30 + 30 + 180, 0 + 2 Pi k + 30 + 60 + 180,
     0 + 2 Pi k + 30 + 270, 0 + 2 Pi k + 30 + 15 + 270, 0 + 2 Pi k + 30 + 30 + 270,
     0 + 2 Pi k + 30 + 60 + 270} , { k, 0, .95 LengthOfString / 360 } ] / / Flatten ) /. Pi → 180 ,
  Flatten [ % ]
  ]

Matching Digit Pairs

  MatchingDigits = c [ [ % ] ]

  d [ [ %% ] ]

Frequencies [ MatchingDigits ]

Histogram [ MatchingDigits ]

Table [ ListPlot [ Transpose [ { Drop [ MatchingDigits, k ] , Drop [ MatchingDigits, - k ] } ] ] ,
 { k, 1, 100, 10} ] --
```

Page 11 line 3 has been added as follows:

-- $\partial^2 Ey / \partial t^2 = A \cos [(-)^{1/2}\ \omega t\ + \Delta\ \varphi°]$

$\partial^2 Ey / \partial t^2 = A \cos [(-)^{1/2}\ \omega t\ + \Delta\ \varphi°]$ *(zero vector)*

$\underline{\partial^2 Ey / \partial t^2 = A \cos (\omega t + \varphi°) + \Delta + (-)^{1/2} + \textit{zero vector}}$ --

Page 11 paragraph 1 line 5 has been amended to:

-- For actuation in signal processing of numeric simulations of measurements to detect objects in the sky using electromagnetic mathematical modeling and electromagnetic measurement systems involves problems and applications of signal identification, data compression, and nonlinear functional mapping. The operators Δ = mechanism of extraction/<u>detection</u> for *match-with-rotate* algorithm, $(-)^{1/2}$ = *yod* for *cusp root method*

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algorithm, and *zero vector* algorithm open new dimensions for finer resolution and less noise. --

In the Claims

Page 12 Claim 1 paragraph 1 line 1 line 8 line 10, paragraph 2 line 5, paragraph 4 line 2 have been amended and paragraph 5 has been added as follows:

--1. Numeric control and modeling of [an uncertain and complex] the statistical mechanics non-congruential generator system of algorithms defined by multiple seed matrices of 1.) *match-with-rotate* for all 16 special angles on the unit circle 2.) *cusp root method*, a descending chain of 7-1 special angles from 5π/6 to 5π/3 (with resonance orbits and infinite loop) on the unit circle and 3.) *zero vector*, i.e. null set of *yod* group, for all 16 special angles from 0πk to 2πk defined in terms of only θ on the unit origin in polar coordinates, which teaches numerical-learning-based algorithms focusing on Artificial Neural Networks used for numerical modeling and control of the [uncertain and complex] statistical mechanics system's dynamics and operating environment for nonlinear functional mapping [consisting] of:

data output for all combinations of seed matrices in sequences of 1.) matching digits 2.) matching special angles in degrees or radians 3.) matching special angle positions 4.) matching special angle positions in terms of sector-area and 5.) one (relative to another), two, three or four input remainder values segmented by $(x_n - x_{n-1}) = r_n$ with empty digit positions intact where the matching digits were extracted/detected from, which are used individually or recombine in permutations to close the system loop; and[;]

programs coded with the algorithms of the operators Δ representing *match-with-rotate* algorithm, *yod* representing *cusp root method* algorithm, and *zero vector* algorithm that produce the data output sequences; and[;]

3-tuple and 4-tuple elements embedded in well-ordered data output sequences for combinations of input values and each combination of seed matrices; and [.]

a method of extraction/detection. --

Page 12 Claim 2 lines 1 and 2, have been amended as follows:

-- 2. [Numeric control and modeling of an operating system or environment that consists of but is not limited to] An article of manufacture in computer readable medium for a program with the properties, $-(-a) = -a$, $\pm 0 - 1 = -$, i^2 does not equal -1, and $-$ does not equal -1, vacuous does not equal True or False, null intersect null = disjoint, sum of vectors in the identity element law is non-commutative by **a + 0** does not equal **0 + a**, the commutative property of multiplication defined as a repeated series of addition such that adding zero five times is valid but adding 5 zero times is not valid, the four values of minimum-maximum $\pm\infty = 1$, and a does not equal zero, a such that $a^2 = 0$. --

Page 13 Claim 4 on lines 4 and 5 has been amended as follows:

-- 4. The system of claim 1 for numeric control and modeling of when the sequences of data output sets in matching digits, matching special angles, matching special angle positions, matching special angle positions in terms of sector-area, and input remainder values segmented by $x_n - x_{n-1} = r_n$ from which the matching digits were extracted/detected in the differential equation $m(dL/d\theta) = \pm kL + mg$ are coded in binary to 1.) simulink simulation code and routed to 2.) microcontroller (d-space), for mathematical modeling and 3.) microcontroller for physical processes to form circuits.--

Page 13 Claim 5 line 8 has been amended as follows:

-- 5. The sequences of claim 1 for numeric control and modeling of when the matching digits sequence is segmented according to the factor theorem, recombined by one-to-one correspondence in coordinate pairs with the matching special angles, and again matched in one-to-one correspondence with matching special angle positions so that the x-component of the coordinate pairs is distributed according to digit frequency over the sector-areas of the matching special angle positions, which are in one-to-one correspondence with matching special angles (y-component) and matching special angle positions for data projection of clusters (FIG. 6). --

Claims 11 and 12 have been added as follows:

-- 12. The claim of 1 for numeric control and modeling in a signal detector (of an antenna receiver) for electromagnetic wave pattern recognition of the source. --

-- 13. The claim of 1 for numeric control and modeling of a ±0°-90°-90° non-Euclidean circuit gate of a receiver. --

Claim 14 has been added as follows:

-- 14. An article of manufacture for a computer readable medium encoded with a computer program for *match-with-rotate, cusp root* and *zero vector* algorithms that count the digits in combinations of e, π, $(2)^{1/2}$ and $(3)^{1/2}$ (or other transcendental, irrational numbers or physical constants with infinite decimal expansions) starting with the first digit and not counting the place descriptor decimal point such that each of 16 special angles from 0πk to 2πk (where k is greater than or equal to 1) is counted in degrees of π = 180 and the sequence of special angles consists of those angles mod 360, which correspond to the 16 special angles between 0 and 2π so that the digits of e π, $(2)^{1/2}$ and $(3)^{1/2}$ decimal expansions match at the same position and the position has a one-to-one correspondence to the same number of degrees defined by a special angle on the unit circle, the algorithms generate an integer sequence of matching digit pairs, a radian sequence of matching special angles, a special angle position sequence, and the special angle position sequence in terms of sector-area. --

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In the Abstract

In the Abstract line 8 has been amended as follows:

-- Three algorithms enumerate the decimal expansions of e, π, $(2)^{1/2}$ and $(3)^{1/2}$ by using 1.) 16 special angles in radians on the unit circle in a transition from arbitrary-degrees to natural-radians defined as Δ (*match-with-rotate* algorithm), 2.) subsets of 7-1 special angles from $5\pi/6$ to $5\pi/3$ derived from the Pythagorean theorem such that $-(-a) = -a$, the square of imaginary i, i.e. i^2 does not equal -1, $-$ does not equal -1, $(-1)^{1/2} = i$, $(-)^{1/2} =$ *yod* (*cusp root method* algorithm), the 10^{th} letter of the Hebrew alphabet, akin to *iota* of Semitic origin, and 3.) 16 special angles in radians on *zero vector* algorithm defined in terms of the *yod* null set of only θ on the unit origin in polar coordinates, for the seed matrices as the mechanisms of sequence extraction<u>/detection</u> whereby numerical-based-learning algorithms focusing on Artificial Neural Networks learn nonlinear functional mapping from [an uncertain and complex] <u>a statistical mechanics</u> non-congruential system for control and numerical modeling. --

REMARKS/ARGUMENTS

All claims remain in this application. Claims 1, 2, 4 and 5 have been amended. Claims 12, 13 and 14 have been added.

Attached hereto is a marked-up version of the changes made to the document and claims by the current amendments. The attached page is captioned <u>"VERSION WITH MARKINGS TO SHOW CHANGES MADE"</u>

Applicant respectfully requests that a timely Notice of Allowance be issued in this case.

Respectfully submitted,

BY <u>Joseph Dale Helmick</u>
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Memo

To: Michael Holmes Fax: (703) 746 7239
From: Joseph D. Helmick
Subject: Last amendment before first office action
Date: April 30, 2002

Please cancel all amendments from the fax sent on March 10, 2002.

Please accept the new amendment included with this fax.

Joseph Dale Helmick

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